

both brighter than 15Jy for UTs and 200Jy for ATs. The visibility of the Science source is absolutely calibrated by observing a Calibration Source. Two calibration modes are offered: Science-Calibration (SCI-CAL) for normal accuracy requirements, or Calibration-Science-Calibration (CAL-SCI-CAL) for high accuracy requirements.

For the correlated flux mode, a CAL-SCI-CAL sequence is mandatory with the additional restriction that the same calibrator star should be used before and after the science target observations. Since correlated fluxes are not normalized like visibilities, they must be compared to other correlated fluxes of the same object taken at different baseline vectors in order to infer the source geometry. A single correlated flux measurement is not useful. As correlated flux measurements are obtained in Visitor Mode, source photometry is taken at the user's discretion. ESO does not guarantee this photometry to be useful, in particular for visibility calibration.

A proposal can consist of different observations of the same target with different baselines and/or hour angles in which case the observing time to be requested is simply computed as the number of required time-slots multiplied by the duration of one slot as given in Table 19. Time-constrained observations (*e.g.* variable objects) can be requested.

### 6.13 AMBER, Astronomical Multi-BEam combineR

AMBER is a near-infrared, multi-beam interferometric instrument, combining up to 3 telescopes simultaneously. In Period 89, AMBER can be used with UTs or ATs. For specifications of the UT and AT performances see Sect. 4.2.2 and Sect. 4.2.4. All possible triplets of UTs are available, and a number of selected AT combinations. For the telescope positions and baseline lengths of the different AT and UT baselines, please refer to [the VLTI baseline page](#).

Because of the limited availability of UTs for AMBER, any scientific programme on the UTs should be designed so that scientifically meaningful results can be achieved in a single night.

**Important note:** UT4 will not be available in April 2012 (Sect. 1.1). In addition, to allow for the installation of the Deformable Secondary Mirror, UT4 will not be available during part of Period 92. Large Programmes using UT4 with AMBER should take this limited availability of UT4 into account.

#### 6.13.1 Spectral Modes and Coverage

The following spectral modes are offered: the Low Resolution H+K bands (LR-HK), Medium Resolution K band (MR-K), High Resolution K band (HR-K) and Medium Resolution H Band (MR-H). For central wavelengths and wavelength coverages for LR-HK, MR-K, MR-H and HR-K see [the AMBER web page](#).

#### 6.13.2 Integration times, DIT

**External fringe tracking with FINITO** is available on both the UTs and the ATs. The use of FINITO allows the entire AMBER detector to be read, maximizing simultaneous spectral coverage. It also allows the AMBER DITs to be adjusted to yield sufficient signal-to-noise ratio per frame in the fringes. However, the DIT has to remain small since, even with the help of the fringe tracker, interferometric fringes get significantly blurred after integrations lasting seconds. Note that medium and high resolution are only offered with external fringe-tracking as standard setup.

**If no fringe tracker is used** (*i.e.* faint and/or extended objects, or airmass too high) the integration times with AMBER will have to be short to minimise the blurring caused by the atmospheric turbulence. In Low Resolution, without external fringe tracking, the maximum authorized DITs are set to 100ms on the ATs and 50ms on the UTs. If *absolute visibility* measurements is the goal, the shortest authorized DITs are recommended (see Table 2 in the Template manual); if *closure-phase* and *wavelength differential-mode* are the quantities of interest, the maximum recommended DIT should be used.

As of Period 89 it will be possible (only in visitor mode) to operate AMBER in self-coherencing mode which significantly improves the quality of data when FINITO cannot be used for fringe tracking. Check the [AMBER Users' Manual](#) for details.

**Special Modes:** Special Programmes may require a different combination of modes and DITs. This is the case when using MR or HR without external fringe-tracking. A shorter DIT strongly reduces the limiting magnitude. It also reduces the spectral coverage that can be read. Any proposal requiring a non-standard DIT should carefully detail the justification and the technical feasibility. It will be scheduled in Visitor Mode.

In Service Mode the AMBER DITs ought to be chosen while preparing the Phase II. The AMBER template manual, available on [the AMBER documentation page](#), provides the recommended DITs for all offered configurations.

### 6.13.3 Limiting magnitudes

AMBER and the VLTI have limitations in magnitude (V-band, H-band and K-band), fringe contrast (H-band and K-band), airmass and seeing. The details of these limitations can be found on [the AMBER web page](#), as well as the most updated values on visibility accuracy and closure phase accuracy.

The limiting magnitudes are estimates on the basis of at least 50% of the frames being successfully processed by the AMBER pipeline. If a lower yield rate is accepted, an increase of up to 0.5 in the limiting magnitude can be achieved. In this case, the user should account for additional integration in the same spectral band (Sect. 6.13.5) to obtain more frames.

The limiting correlated magnitude depends on the AMBER spectral resolution, the FINITO tracking mode (No-Tracking, Group-Tracking or Fringe-Tracking), and the seeing conditions. The main interest of FINITO Group-Tracking at faint magnitudes is to enhance the SNR on the AMBER closure-phase, but reducing the flux in the H-band.

In order to be observable with FINITO, the target should have:

H magnitude:	-2 to 5 (ATs)	1 to 7 (UTs)
Visibility in H:	> 15% (ATs)	>10% (UTs)

### 6.13.4 Calibration strategies

AMBER requires frequent calibration on-sky, using calibrator stars. We offer two calibration modes: “CAL-SCI-CAL” and “CAL-SCI”. The first one is the standard mode which should be used in most cases, in particular when *absolute calibration* is required for best accuracy. Absolute calibration is required in most programmes, but for some programmes *wavelength differential quantities* provide the astrophysical information. In that case, “CAL-SCI” (or indifferently “SCI-CAL”) is sufficient.

The choice of on-sky calibration strategy should be specified in the “calibration request” section of the proposal. **The strategy will be reviewed particularly carefully during the technical feasibility. Proper justification must be provided if “CAL-SCI” is requested instead of the standard “CAL-SCI-CAL”.**

### 6.13.5 Execution times

For each Observing Block (OB), either SCI or CAL the proposer(s) should consider the following:

- Acquisition requires 10min in HR or MR, 5 minutes in LR, including the spectrograph setup and the recording of the calibration fringes (so called P2VM). See Table 19 for more details.
- Integration requires 15min. A maximum of 3 integrations is allowed per OB, which could consist in repeating 3 times the same integration or 3 integrations around 3 different central wavelengths *within the same spectral setup*.

Hence a normal “CAL-SCI-CAL” sequence requires 75min in MR or HR and 60min in LR.

When observing targets close to the limiting magnitude in MR or HR, it is recommended to double or triple the integration, and to focus on *wavelength differential quantities*. Hence a “SCI-CAL” sequence with triple integration requires  $2 \times 1\text{h} = 2\text{h}$ .

Using a non-standard DIT (below 200ms in MR and HR, or below 25ms in LR, see Sect. 6.13.2) can strongly reduce the spectral coverage available within one integration. To obtain measurements at different position within the range of the spectrograph setup, the user can use 2 or 3 integrations with different central wavelengths.

## 6.14 VIRCAM, VISTA InfraRed CAMera

VISTA (Sect. 4.2.5) is equipped with the near infrared camera VISTA InfraRed CAMera (VIRCAM), which covers a 1.65 degree diameter field of view with a loosely packed detector mosaic totalling  $\approx 67$  million pixels of mean size  $0.339''$ . The point spread function (PSF) of the telescope+camera system including pixels is measured to have a FWHM of  $0.51''$ .

Further information on this instrument can be found on the [VISTA web page](#).

### 6.14.1 Filters

The filter wheel of VIRCAM has eight slots. One is reserved for a blank, and the rest holds the filters listed in Table 17. “Visitor” filters can be accommodated by replacing one of the currently available filters, but the specifics of the cryogenic instrument and the usage of the current filters in already scheduled surveys makes this difficult. Filter exchanges must be linked to instrument and telescope maintenances which are expected to occur about once every two years. Please contact [usd-help@eso.org](mailto:usd-help@eso.org) for further details.

Table 17: VISTA filters

Filter	Wavelength [ $\mu\text{m}$ ]	FWHM [ $\mu\text{m}$ ]	Comment
Z	0.88	0.12	required by public surveys
Y	1.02	0.10	required by public surveys
J	1.25	0.18	required by public surveys
H	1.65	0.30	required by public surveys
Ks	2.15	0.30	required by public surveys
NB1.18	1.18	0.01	required by public surveys
NB980/NB990	0.98/0.99	0.01	2 sets of filters in one slot; require instrument rotation for complete observations

### 6.14.2 Focal plane geometry

The sixteen  $2048 \times 2048$  pixel IR detectors (Raytheon VIRGO HgCdTe  $0.84 - 2.5\mu\text{m}$ ) in the camera are not buttable and are arranged as shown in Fig. 8. The diagram shows the focal plane as it would be seen looking directly down the camera body (down the Z-axis which on the telescope points towards the sky). On the sky (in the default instrument rotator position) +Y corresponds to N, and +X to West.

A single integration of length DIT secs (or a co-added series of these known as an Exposure) produces a sparsely sampled image of the sky known as a **pawprint**. The area of sky covered by the pixels of a pawprint is  $0.6 \text{ deg}^2$ . Full, almost uniform, sky coverage of a **tile** of  $1.501 \text{ deg}^2$  can be achieved with six pawprints, offset by  $\pm 47.5\%$  in y at two respective x-positions offset by 95% of the detector size. Any sky position of a tile will fall at least on two of these six pawprints.